

Wimbledon Common: its Geology, Antiquities and Natural History. By Walter Johnson. Pp. 304. (London: T. Fisher Unwin, 1912.) Price 5s. net.

THE natural history—using the term in its widest sense—of any restricted area has a charm of its own, though it may appeal but to a limited number. A thorough study of the geology, antiquities and natural history of a district is a valuable piece of education, somewhat akin to the study of “types” in biology, and anyone who has pursued such a course will have his interest stimulated, and be in a far better position to enjoy the charms of his own or of a foreign country than had he not done so.

The present book deals with Wimbledon Common, a stretch of moorland and wooded country, in the heart of which it is difficult to realise that Whitehall is but half-a-dozen miles or so distant. An interesting account is given of the geology, botany and zoology of the district, and the antiquarian and historical sides are well done. We have a personal acquaintance with the common and can testify to the general accuracy of the book, and the perusal of it has added much to our knowledge of the district. Mr. Johnson expresses the hope that his chapters may be of service in the cause of “nature study,” and we can cordially recommend it for such a purpose. The book is well illustrated with a number of plates and drawings and four maps. R. T. H.

Telephotography. By C. F. Lan-Davis. Pp. xi + 130. (London: G. Routledge and Sons, Ltd., n.d.) Price 2s. net.

THE getting of a large enough image of distant objects, or of near objects without an unpleasant proximity to them, is a difficulty that often presents itself to the photographer. A lens of greater focal length is theoretically serviceable in such cases, but the long camera that it would require may not be available, and if provided would often be troublesome to manipulate. This accounts for the popularity of telephotographic lenses. Some of them have the positive and negative elements fixed with regard to each other, and then they differ little, if at all, in their use from lenses of the ordinary simple type. But when the two elements are adjustable with regard to each other, in order to allow of obtaining various sizes of the image many new problems arise. We therefore welcome this little volume, in which these problems are dealt with in a practical and very concise manner.

The book includes some remarkable illustrations, such as a photograph of Mount Kenya, in British East Africa, taken from a distance of ninety miles, while at the other extreme as to distance is a photograph of an Emperor moth about life size. A short chapter on “telephoto-micrography” deals with an application of these lenses that is too often neglected. The magnification conveniently obtainable with instruments at present on the market is always very low, the advantage being in the greater distance between the lens and the object, which improves the perspective and facilitates the lighting.

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LETTERS TO THE EDITOR.

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The Natural Fracture of Flint.

SIR E. RAY LANKESTER, K.C.B., in his learned and comprehensive article in NATURE of November 21, has suggested the various lines of research which it will be necessary to follow if a thorough-going knowledge of the mode of origin, structure, and fracture of flint is to be obtained.

The first two, which are intimately associated with the sciences of chemistry and physics, I am, owing to a lack of knowledge of these subjects, unable to deal with. But having for some time past carried out a series of experiments with flints subjected to natural percussion and pressure, I have been able to discover certain facts which I think may interest prehistorians, and help them to decide with more certainty what is human flaking upon any given stone, and what is not.

In order to provide conditions in which flints would strike each other fortuitously, I could think of no better plan than to get a large sack, and, placing eight or nine stones in it, shake it violently about for some considerable time, and afterwards observe whether any of the flints had been flaked in the process.

For my experiments with pressure I used a converted letterpress and a differential screw-press, with which very considerable pressures were obtained.

The rudimentary character of these appliances may be used by some as an argument against the value of the results obtained, but it seems to me that the nature of a blow does not differ whether it is delivered in my sack, or on a sea-beach, or in a fast-running river. In the same manner, pressure is pressure, whether applied in my presses or under a mass of gravel, ice, or other weight of material.

Moreover, I have noticed that stones found on sea-beaches which have been flaked by the action of the sea exhibit the same characteristics as those resulting from my sack experiment, and I think that the flaking on my specimens will be found to be in accord with that of any stones from any geological deposit which can be proved to have been flaked by fortuitous blows or pressure.

I propose now to give a description of the flaked specimens resulting from my experiments, and to show how, in my opinion, they differ from flints found in various pre-river-drift deposits, and which I and others look upon as having been flaked by man.

I will deal first with those chipped by fortuitous blows in my sack experiment.

(1) Flaking was produced upon stones which were more or less of a wedge shape, the thinnest end of the wedge being that from which the flakes were removed.

In the deposits which we examine we find that the flaked flints are of all and every shape, and this leads us to conclude that man has been the fracturing agent.

(2) The large majority of the fortuitous flakes were short and cut deeply into the stone, showing that the blows which caused their removal had impinged almost directly upon the edge itself. This opinion is supported by the fact that the edge is blunted where blows have fallen upon it.

The large majority of the flakes which have been removed from the stones considered to be human are, in the first place, differently formed and longer, and

were evidently detached by blows delivered *on the side of the edge*.

When flaking flints I find that it is only this type of blow which will produce a sharp cutting edge; I conclude that these were flaked for that purpose, and consequently that they have been fabricated by man for some cutting or scraping purpose.

(3) The fortuitous flakes also nearly always show on their surfaces prominent undulations or ripple marks, caused by the fact that they were detached by blows which struck the edge obliquely (Fig. 1).

As there are 180 angles at which a flake can be removed from the edge of a flint, and as it is only the higher angles which will remove flakes showing no ripple-marks, it is seen that nature has many more chances of delivering oblique blows which detach flakes showing this peculiarity. Observations have shown that as the obliquity of the blow increases or decreases, the visibility of the ripple-marks increases

also at right angles to the ripple-marks as they curve upwards (Fig. 4).

These three lines must then be continued out until they meet, and the point of juncture will be found to be the spot where the blow fell which detached the flake. The other method is to examine the surface of the flake for those small fissures which result from a blow and "fan out" from the point of impact (Fig. 5).

The flints considered to be "human" show that the flakes have been removed at a *constant* angle to the edge of the flint, and by flaking stones I find that this must of necessity be so (Fig. 6). To try to put an edge on a flint by blows delivered at different angles would be a very troublesome and useless procedure. I also found that the flaked edges of the flints produced in my sack experiment showed a large number of truncated flakes. On one specimen I counted seventeen on one edge $4\frac{1}{2}$ in. long. These truncated

flakes are those which have got diminished in size or cut off by the later flaking of the edge (Fig. 7).

In my sack experiment, where the rain of blows is practically continuous, the edge of the flint is continually being re-flaked, and in consequence truncated flakes are formed. On the other hand, the stones I look upon as having been humanly struck do not show many truncated flakes, and, as when flaking flints myself I find it is not necessary to make many such flakes in forming a cutting edge, I conclude that man has been the fracturing agent in the case of these specimens.

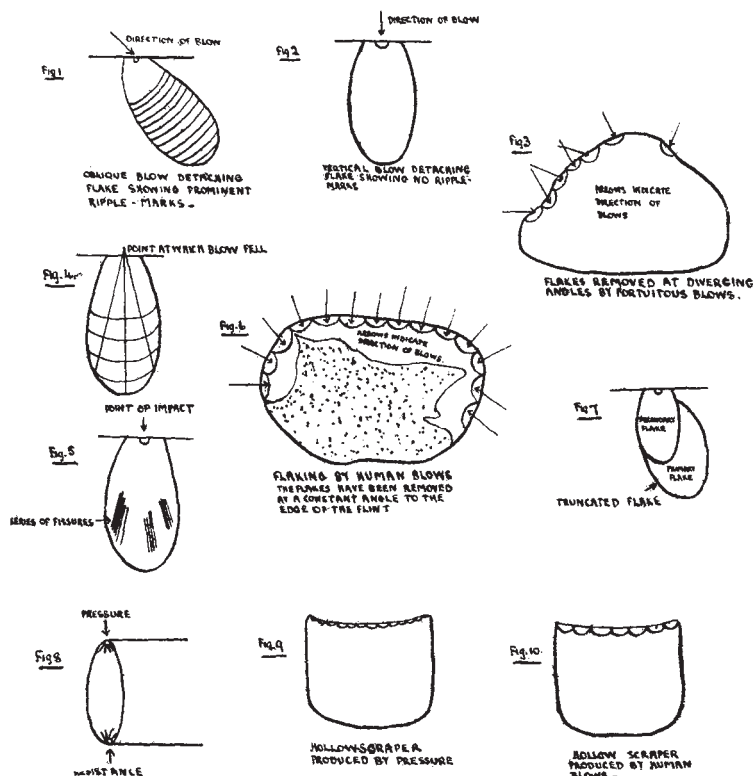
In nearly every flint which I have flaked by fortuitous blows I find that a distinct sinuous edge, similar to that seen upon many Palæolithic and Neolithic implements, is produced, and at first sight might lead to the conclusion that nature can exactly imitate man's work, but an examination of the details of the individual flakes, such as I have outlined above, at once shows that this is not so.

I will now give the results of my experiments with flints under pressure.

(1) I find that when a flint is placed upon the hard floor of the press, and a large amount of pressure exerted upon it with the ram, it will break in half, and that the broken surface exhibits two bulbs, at each point where pressure and resistance acted (Fig. 8).

The bulb which is formed on the side of the flint resting on the floor of the press is always more prominent and better formed than that at the opposite side, where the ram impinged. I am, however, unable at present to say why this should be so. None of the flaked flints found in the pre-river-drift deposits show these two bulbs, and I therefore conclude that man has produced them, because it is impossible to form two such bulbs on one flake by detaching it with a blow.

(2) It was found that if a folded duster or piece of cloth was placed upon the floor of the press, thus giving the flint a soft base upon which to rest, with greater pressure than was needed in the former case, a flake was detached showing only one bulb. This bulb, however, is of a different character from one produced by a blow, being flat and only partly developed, and as I do not find such bulbs on the flints we look upon as "human," I conclude that man



or decreases. It has been found that to detach a flake obliquely is a very difficult task, and that generally in doing so several blows have to be delivered which have the effect of shattering and blunting the edge which is being produced.

It is, however, a very easy matter to detach flakes by *vertical* blows (Fig. 2), and, moreover, by so doing an excellent sharp edge is formed. As the flaked flints I find have been flaked by vertical blows, I conclude that man has been the fracturing agent.

(4) It was also noticed that the fortuitous flakes had been removed by blows falling at different angles to the edge of the stone (Fig. 3).

The method I adopt to arrive at the angle at which the blow fell which detached any particular flake, if the actual bulbar cavity is not visible, is to draw a line down the centre of the flake and at right angles to the ripple-marks, and then to draw two others on each side and at equidistant from the centre one, and

produced those showing on these latter specimens (that is, of course, when they have obviously not been detached by fortuitous blows).

(3) I find that by bringing pressure to bear upon a flint with a sharp edge resting upon a rounded pebble a "bay" can be produced upon the uppermost stone which has the appearance of a "hollow scraper" made by man.

By carefully watching one of these sharp-edged stones in the process of being flaked, it was seen that so long as the pressure was applied the flaking was continued.

The flint was evidently breaking along the lines of least resistance, and very thin flakes being removed, the hollow produced having a totally different appearance from one made by blows.

The reason for this difference was seen to be owing to the fact that as it is impossible to strike the flint near enough to its edge to remove flakes as thin as are detached by pressure, the hollow scraper produced by blows has a rougher appearance because each individual flake has cut deeper into the flint (Figs. 9 and 10). The hollow scrapers which are derived from the pre-river-drift deposits have obviously been produced by blows, delivered at a constant angle to the edge, and it is therefore concluded that man has made them.

It is, of course, possible that these early men in some cases may have edge-flaked their flints by pressure applied with another stone or a bone point, as the later Neolithic people did, but it does not seem likely that this was the case. Experiments were conducted with flint flakes covered by an inch or inch and a half of fine sand in an iron dish, and it was found that the greatest pressure obtainable with the differential screw-press was unable to break them.

A similar experiment was also conducted under the same conditions except that no iron dish was used and the sand was allowed to flow under the pressure. Here again, however, no fracturing of the flint took place. I think these results should induce caution in asserting that large stones lying under many feet of fine sand have been broken by pressure. I found that with pressure-flaking the small fissures in the flint, which are so common in flaking by percussion, are very rare, and I think this is due to the different methods of fracture. Also the surface of a pressure-flake is very seldom so glossy as that produced by a blow, which fact can perhaps be explained on the same hypothesis.

I may say that my experiments were carried through a great number of times with all sorts of flints, and the same results obtained.

In conclusion, I would like to state that specimens demonstrative of all the foregoing experiments are housed in the department of ethnology of the British Museum (Bloomsbury), and can be seen and handled by anyone who wishes to do so.

I. REID MOIR.

12 St. Edmund's Road, Ipswich, November 25.

Excitation of γ Rays by α Rays.

In a paper shortly to be published in *The Philosophical Magazine*, one of us has shown that when the α rays from radium C impinge upon matter, they excite a small but detectable amount of γ radiation. In continuation of this work a systematic investigation of the radiations from bodies which expel α rays has been commenced. So far the radiations from ionium, radio-thorium, and radio-actinium have been investigated. Working with a very strong source of ionium, we find that, after all radio-active products likely to emit β or γ rays have been removed by chemical treatment, ionium emits, in addition to its α rays, a certain amount of γ radiation, but no detectable amount of β radiation. The amount of γ radiation

compared with the total α radiation is much smaller than that emitted by a typical γ ray product like radium C. The amount, however, is of about the same order as that excited by the α rays of radium C in external matter. Since there is no evidence of the existence of a product accompanying the ionium and emitting γ rays only, it is natural to suppose that these γ rays are excited either in the ionium or in the thorium which is mixed with it, by the α rays.

Analysis of this radiation by means of absorption measurements gave the interesting result that it consists of three types at least. The least penetrating of these consists of a radiation, the absorption coefficient divided by the density (μ/D) of which has a value in aluminium of about 400 (cm.)⁻¹, the second of about 8.2, and the third type, which has not been investigated in detail owing to the weakness of the source, of about 0.15, i.e. it is of about the same order of penetrating power as the hard γ rays from radium C, viz. 0.04. It will be noticed that the second type has approximately the same value of μ/D as the characteristic radiation of series L excited by X-rays in thorium, as found recently by Chapman. It is therefore natural to suppose that all three types are characteristic radiations of ionium of different series.

We find also that radio-thorium emits γ rays, and also a small amount of β radiation. This radiation has not been studied in as much detail, owing to the rapid formation by the radio-thorium of thorium X and subsequent products, expelling intense β and γ rays. The ratio of the amount of γ to α radiation emitted by radio-thorium is approximately the same as the corresponding ratio for ionium.

The results obtained with radio-actinium, which is the product in the actinium series corresponding to radio-thorium in the thorium series, and to ionium in the uranium series, are very different. Dr. Hahn has shown that radio-actinium emits, in addition to α rays, some soft β rays, and also a radiation which is either a hard β or a soft γ radiation. We have repeated his work, and find that it expels, in addition to soft β rays, γ radiation of two types, the more penetrating of which is of the same order of penetrating power as the hard rays from radium C. The amount of β and γ radiation emitted by radio-actinium, however, is much too large to be ascribed to α rays alone.

It has hitherto been supposed that radio-actinium is a single product, having a period of 19.5 days, but we have succeeded in showing that it consists of two successive products. The parent product has the period of 19.5 days, as found by Hahn, and emits little or no penetrating β or γ radiation, and very probably no α rays. The second product expels α , β , and γ rays, and has a period of about thirteen hours. So far we have not succeeded, by means of a single chemical operation, in separating completely one product from the other, but, by means of a series of operations, we have been able to obtain a fraction of either product free from the other. It is of interest to note that Dr. Geiger and Mr. Nuttall predicted, from their well-known relation between rate of transformation and range of α rays, that radio-actinium probably consists of two successive products, the first of these having the period of 19.5 days, as found by Hahn, and the second giving the α rays and having a period of about one day. It is seen that this prediction was surprisingly accurate.

We intend to continue this work by investigating the γ and β radiations expelled by intense sources of radium, polonium, thorium X, and other α ray products.

J. CHADWICK.

A. S. RUSSELL.

Physical Laboratories, Manchester University,
December 16.